Berat Cacu

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| Portfolio Website

Profile

Fourth-year Physics undergraduate at Boğaziçi University pursuing a double major in Mathematics, with growing specialization in mathematical physics. My current research interests focus on the intersection of theoretical physics and advanced mathematics, particularly in General Relativity and its modern extensions.This dual physics-mathematics perspective informs my approach to theoretical problems, where I seek to combine physical intuition with mathematical precision, particularly in studying emergent spacetime phenomena.

Education

- **Boğaziçi University** 2021–Present
  B.S. in Physics GPA: 3.6/4.0
  Double Major in Mathematics GPA: 3.6/4.0

Research Experience

- **Metin Arık Research Group** Spring-Summer 2025
  Advisor: Metin Arık
  - General relativity and emergent gravity theories. The thermodynamic properties of spacetime. Horizon thermodynamics and Bekenstein-Hawking entropy. Verlinde and Jacobson interpretations on entropic gravity.
  - Covariant formalism of spacetime entropy in local Rindler horizons compatible with Jacobson's emergent gravity theories. Covariant convergence of entropy tensor and second law of thermodynamics. Entropy flux across local Rindler horizons. Covariant formalism for entropic force and solution with FLRW flat spacetime.

Notes and Preprints

- **Entropy Tensor of Spacetime** Proposal of a rank-2 entropy tensor for the entropy tensor of spacetime $S_{\mu\nu}$ constructed from energy momentum tensor $T_{\mu\nu}$ and scalar temperature field. Covariant conservation of entropy tensor and temperature gradient. Entropy tensor of spacetime
- **Presentation Notes on Conformal Transformations**. Riemann tensor, Ricci tensor and Ricci scalar under conformal transformations. Invariance of the Weyl tensor. Conformal Transformations

Teaching Experience

- Laboratory Assistant-Electromagnetism Experiments(Phys 201)
- Laboratory Assistant-Modern Physics Experiments(Phys 202)

Presentations

- **Conformal Transformations** May 2023
  Place: Bogazici University, Istanbul
  Introduction of conformal transformations. The invariance of spacetime structure and null geodesics under conformal transformations. The structure of Riemann tensor, Ricci tensor Ricci scalar under conformal transformations. Introduction of Weyl tensor and the invariance of Weyl tensor under conformal transformations. For presentation notes check :Presentation notes.

Outreach Teaching

Summer School for High School Students on Mathematical Foundations of Physical Problems (in Turkish)
Program file in Turkish